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FROM TECHNOCRACY TO VENTURE FIRM

Experiments And Lessons In NASA's Transition To An Instrument For Economic Growth

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I. Introduction

In 1993 President Clinton and Vice President Gore issued a policy document entitled Technology for America's Economic Growth, A New Direction to Build Economic Strength. In it the President establishes economic competitiveness as a new and key measure of performance for government R&D efforts, including NASA programs, and he identifies four precepts of the new technology policy profoundly effecting how NASA was to execute its mission.
Investing in technology is investing in America's future.
American technology must move in a new direction to build economic strength and spur economic growth.
NASA must modify the ways it does business to encourage cooperative work with industry in areas of mutual interest.
At the level of technology application, a fundamental mechanism for carrying out this new approach is the cost-share R&D partnership between government and industry.

A little more than a year after the President's policy was issued, NASA responded to the challenge with vigor by releasing its own policy document: Agenda for Change. At the core of Agenda for Change resides a central premise, and one that has been echoed frequently since by NASA's senior leadership – that NASA would shed its command and control culture to remake itself into more of a partner with industry and less of an overseer:

In order to ensure national economic security impacts of NASA programs, NASA will pursue a commercial technology mission concurrent to its aerospace mission. The commercial technology mission will require that each NASA program be carried out in a way that proactively involves the private sector from the onset, through a new way of doing business, to ensure that the technology developed will have maximum commercial potential.

Continuing on: "This new mission requires NASA to impart, to the maximum extent possible, the benefits of its technological assets to the national economy and to use, to the maximum extent possible, the strengths of the U.S. industrial base". In order to accomplish this, the policy identifies 11 "basic cornerstones."

Technology Investments: 10-20% of NASA's budget to R&D partnerships with the private sector.
Partnerships: Between NASA, industry, other agencies and academia - to include dual use development partnerships, industry-led partnerships, commercial technology acquisition and others.
Minority, Small and Disadvantaged Business/Equal Opportunity: Strengthening a long-standing commitment.

State/Local/Federal Alliances: Building upon infrastructure, resources, and a culture of innovation to develop and transfer commercial technology.
Field Center Led Implementation: Delegating more authority and leadership to Field Center Directors in promoting commercialization.
R&D Procurement Commercialization Objectives: Requiring all procurement activities to define commercialization plans.
Metrics: Uniform, standardized measures of performance for resource allocation and management decision making.
Electronic Commerce: To be instituted as standard practice to replace paper, documentation, storage, transmission, and authentication.
Marketing: Seeking non-aerospace partners for R&D collaborations where synergy exists.
Training and Education: Providing new training to NASA employees on implementing its commercial mission.
Employee Accountability: Making each research professional accountable for commercialization.

Moreover, in the document, NASA proclaims each tenet in the affirmative, and in so doing it set a bold course for change.

The changes Agenda promises would be structural, cultural and complete – invading every corner of the agency and the very way it thinks about itself and its relationships with others. NASA would implement a "New Way of Doing Business" – a commercial way. It would become a sophisticated, aggressive, and business-like consumer of and purveyor of technology both, and it would reform itself in the image of the nimble and adroit American corporations of the 90's.

Most importantly, NASA would undergo a paradigm shift in its R&D and management philosophies – from an internally oriented organization that heavily emphasized performance and novelty in its research, and, just as heavily, requirements, conservatism, and direct oversight in its procurements; into an organization that was more open and participatory, and did much more to cultivate relationships with industry and to spark economic growth. NASA would accomplish this through new business practices that would elevate Contractor Developed Technology Commercialization, Industry-led Technology Development Partnerships, Dual-use Technology Developments, Commercial Technology Acquisition, Small Business Technology Development and Commercialization, and Post Technology Development Diffusion to a level of importance equal to any of NASA's more traditional business practices.

Almost three years after these pronouncements, where is NASA in this process today? Has change taken place? Is a paradigm shift taking hold in NASA? Is NASA a more efficient engine of economic growth today? And, is NASA becoming a better partner with American industry as a collaborator, as a consumer, as an investor?

Preliminary indications, while not conclusive, suggest that yes, indeed, there are encouraging signs of substantial progress, but much of the promise of the new paradigm is yet to be realized due to fundamental change which is needed both in the NASA institution and the aerospace industry alike. Several examples of change which are ongoing now or have occurred in the 2-1/2 years since Agenda was released serve to illustrate these points. These examples will demonstrate both the promise, and some of the difficulties and challenges remaining if NASA is to be remade as proclaimed in Agenda for Change.

II. The New Millennium Program

One of the more visible examples of change is the creation of NASA's New Millennium Program (NMP). By augmenting NASA's traditional internally run systems engineering practices with integrated teams (Integrated Product Development Teams - IPDTs) of NASA technology experts and representatives from industry and other federal agencies, and asking these IPDTs to manage technology developments jointly, and by forcing high risk/high return technology experiments into flight missions which are themselves pathfinder missions against NASA's long range objectives, this program is making great strides at experimenting with new methodologies for project management as well as furnishing to new technologies a very necessary and, until recently, underemphasized bridge to flight implementation. Since many of the technologies are chosen purely for their future potential, the program serves as a proving ground for the entire aerospace community. Moreover, the institutionalized interplay with industry, and the adoption of preferences for commercial technology and commercialization potential as selection criteria are the most concrete of evidence that, at least within the NMP, Agenda For Change is being followed. But the implementation through the IPDT model has had its problems as conflicting competitive interests between members, and frequently unsupportive procurement laws and regulations, complicate relationships between the members and NASA as the sponsor. Additionally, by infusing higher levels of risk throughout each flight, NMP program management has experienced conflicts with more conservative, traditional project management methodologies. Hence, while this indicates a healthy challenge to the old mores is in swing, it also suggests resistance to change is present in NASA's larger project management community. And since NMP's management models have yet to be proven against any objective metrics, and are yet to be exported outside the Program itself, it is too early to claim the NMP a success, or that the new ways are in general effective. It is, however, important to recognize how significant and complete the Program's incorporation of the Technology Development Partnership model has been, and to credit the Program for the dedication and leadership it has shown in experimenting with the new ways. Overall, the New Millennium Program must be viewed as an important experiment in change for NASA which should be watched closely, but also a program too early in its life cycle to be seen as a signal of a paradigm shift.

III. The Hubble Space Telescope Dual Use Technology Initiative

Late in 1994, a few months after the release of Agenda for Change, the Hubble Space Telescope Project management, emboldened by its mission success of the previous year and the serendipitous transfer of its CCD technology for breast mammography and biopsy applications, initiated an effort to promote dual-use technology developments and the direct commercialization of several of its more significant technologies. The effort began by soliciting project ideas from the project's chief technologists and contractors. Several promising projects were identified and a staff position was created to advocate and manage the efforts. This initiative, probably more than any other effort within NASA at that time, strove to fully infuse the directives of Agenda into a mainline NASA mission. Projects were vigorously pursued representing every type prescribed by the paradigm: Contractor Developed Technology Commercializations, Industry-led Technology Development Partnerships, Dual-Use Technology Developments, Commercial Technology Acquisitions, Small Business Technology Development and Commercialization's, and Post Technology Development Diffusion Projects.

The initiative generated exciting concepts and promoted them to the highest levels of NASA, and new relationships between the project, its contractors, outside parties, and the NASA Technology Transfer community were formed. After approximately two years of effort the initiative had spawned

or helped bring forth: 1) A dual use Cooperative Agreement to develop advanced inertial guidance technology for new space and oil drilling applications between the developer of the technology, the state of California, the HST Project itself and two other NASA flight projects, and the Goddard Office of Commercial Programs 2) A pathfinding joint effort to test and foster the commercialization of advanced ultraviolet imaging technology for high voltage power line inspection and high power electric motor quality inspection applications between the device's developer, the HST Project, and the Goddard Office of Commercial Programs, 3) A licensing proposal to commercialize the design of an advanced power tool developed for Hubble's servicing from a manufacturer of industrial power tools, and 4) A national partnership to advance the state of the art in high precision optics and associated systems technologies for future generations of semiconductor fabrication equipment and space telescopes between a manufacturer of very high precision optics, the NASA Goddard Space Flight Center, a manufacturer of semiconductor fabrication equipment, and a not-for-profit firm representing an R&D consortium of the country's leading semiconductor manufacturers.

The Hubble initiative was unusual for its entrepreneurial drive and its sponsorship in the heart of a flight project. It also was terrifically successful at generating worthy ideas with significant rewards to NASA, the companies involved, and the national economy – most notably the semiconductor industry partnership. It was also noteworthy for its success in generating significant direct industrial investment in its projects – well into seven figures in one case, and for its ability to leverage additional modest investments from the existing budgets of flight projects and the NASA institutional technology transfer program. But it is important to note that, despite its aggressive efforts, and support from even the highest levels of NASA, and industrial financial commitments, it failed in one crucial test of the new paradigm – it did not win direct funding support for its dual use projects from the NASA offices directly responsible for technology development funding. In every instance, internally oriented, NASA-dedicated, efforts won out in competition for scarce development dollars over the less NASA centric joint proposals from the Hubble initiative. Even when the proposals contained significant strategic benefits for NASA, in terms of leverageable plant and process technologies, and substantial intellectual property rights for trivial investment amounts – the uncertainty and unfamiliarity of the dual use, industry-led development concept, and the lack of institutional support systems and processes prevented favorable funding decisions.

Thus, the Hubble experiment stands as a significant test and sample point of both the potential of the commercial technology business practices and of NASA's institutional readiness for this change. It is clear from this experiment that NASA's space technology has great potential as an engine for economic growth, but institutional reform of a more serious nature will be required if this promise is to be realized.

IV. The Mission to Planet Earth's Commercial Strategy

Perhaps the NASA enterprise most likely and logical to fully embrace and implement the new ways of doing business is the Mission to Planet Earth (MTPE) Program. With commercial firms hotly pursuing markets in Earth remote sensing information products and the MTPE not only needing information of similar specifications but also experiencing serious budgetary pressures – a fertile environment should exist for the partnership model to establish roots as a mainstream program management methodology. This indeed has begun to occur.

At the end of 1996 the MTPE Program released the clearest endorsement yet of industrial partnership as a preferred management model for a major NASA enterprise. They called this "The MTPE

Commercial Strategy", and its tenets are twofold. The first is to put in place business practices to leverage industrial capabilities to: a) directly furnish Earth remote sensing information products to satisfy MTPE needs, b) establish partnerships to jointly develop or share costs in developing assets and other systems generating Earth remote sensing information products, and c) realize cost savings and other advantages from the application of production space and ground systems in MTPE procurements. The second tenet is to promote policies and practices which will encourage private investment in Earth remote sensing information technologies, and stimulate the development of commercial markets for this information. To implement this, new data policies are being developed that are more sensitive to the full-range of commercial interests in the data, and direct investments are being made in new information technologies and, very recently, data products as well. NASA's Center for Commercial Remote Sensing at Stennis Space Center in Mississippi is managing the investment content of the effort to provide industry "one stop shopping". Thus, through its "Commercial Strategy" the MTPE has begun the difficult process of institutionalizing the new paradigm promoted in Agenda for Change, and, importantly, is taking deliberate steps to incorporate both the partnership model and the economic growth imperative in its management decision processes. Furthermore, management has taken the critical step of creating a permanent staff position within the Program Office with responsibility to integrate and implement the strategy throughout the enterprise.

Based on current efforts, MTPE's commitment to the new paradigm is real. As part of a top-down review of the enterprise, plans are being drawn up to institutionalize interaction with industry to unprecedented levels of involvement, recommendations are being made to implement new data policies and procurement strategies, and management processes are being conceived to assess and manage partnership opportunities and to track the return from the program to the economy and society at large. Also, experiments are underway to test the efficacy of the newer data policies and partnership ventures. One such experiment in new data policies is being carried out in cooperation with the New Millennium Program through the use of its developmental Earth Orbiter-1 (EO-1) spacecraft due for launch in 1999. For EO-1, policies are being explored to permit the partially exclusive commercial use of its derivative data products, under certain conditions, for the purpose of stimulating investment interest and developing commercial markets supporting hyperspectral space systems. If successful, NASA would hope to leverage the resultant future capabilities to partially satisfy its scientific data needs, as well as assist in the creation of new information products for various commercial users. Other important experiments are being managed through Stennis's Center for Commercial Remote Sensing and include funding opportunities for the joint development of value-added information products, and funds to seed the purchase of data products meeting MTPE's needs. And still others are in development at Goddard Space Flight Center, the MTPE's home field center, such as procurement vehicles to streamline space system procurements. Without question, the MTPE is testing the waters of the new paradigm, and to its credit its actions have been largely self-directed.

V. Lessons Learned / Conclusions

The paradigm promoted in Agenda for Change is by no means a panacea. Nevertheless, government agencies rarely issue manifestos of this sort unless there is a seriousness of purpose in carrying them out, and thus it is appropriate and fair to report and reflect on the agency's performance in making good on its promises. Certainly, resistance to this change is present today in NASA , but by far the greatest obstacle in the path of the new paradigm is the systemic cultural and managerial unfamiliarity with cooperative ventures and the realities of competitive industry. The experiments of the New Millennium Program, the Hubble Dual-Use Technology Initiative, and the

MTPE Commercial Strategy demonstrate both the tremendous promise of the new philosophy and, at least in isolated cases, NASA's willingness to move in this direction. But these experiments also serve to illustrate that the management processes and institutional support systems necessary to implement a new way of doing business do not yet exist within NASA to any large degree, or in any consistent form. Success in these particular cases, and in implementing the new paradigm throughout NASA, is, to a great extent, dependent on the courage, competence, and determination of the change agents who are at work in these and similar other experiments throughout the agency. Their accomplishments to date demonstrate that the individual talents and energies exist within the organization to effect change, but questions remain as to NASA's institutional commitment to the process. In issuing Agenda for Change NASA was declaring its liberty to redefine itself in a bold and vital new direction, yet far more support, and more consistent leadership, is needed from throughout the NASA institution if the fundamental change promised is to come to pass.